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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/663,949  
Filing Date: September 16, 2003  
Appellant(s): RUKA ET AL.

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John P Musone  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 7/2/09 appealing from the Office action mailed 11/13/07.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

Appeal 2007-4240

Application 10/663,949

Technology Center 1700

Decided October 31, 2007

Regarding the previous reversal by the Board of Appeals, new art was/is applied against the appealed claims.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

5,589,285	Cable et al.	12-1996
5,035,962	JENSEN	7-1991
3,503,809	H.S. SPACIL	3-1970

H. Tsukuda, A. Notomi and N. Hisatome; "Application of Plasma Spraying to Tubular -Type Solid Oxide Fuel Cells Production"; Journal of Thermal Spray Technology, vol.9(3) September 2000; pp.364-368

R.M.C Clemmer and S.F. Corbin; "Processing and properties of porous Ni/YSZ metal/ceramic composites"; Metal/Ceramic Interactions, Proceedings of the International Symposium on Metal/Ceramic Interactions, Montreal. Aug. 11-14, 2002. Canadian Institute of Mining, Metallurgy, and Petroleum. pp. 231-243; edited by Drew, R.A.L., Pugh, M. Brochu.

Herbert Herman, Christopher C. Berndt and Hougong Wang; "Plasma Sprayed Ceramic Coatings"; Wachtman, J. B. and Haber, eds. Ceramic Film Coatings. 1993. William Andrew Publishing/Noyes. pp.131, 138, 139.

INCO Company; Incosp.com;

Rare Element Resources Ltd; Stephen B. Castor and James B. Hedrick  
<http://www.rareelementresources.com/s/Overview.asp>

Frank H. Spedding, "Rare-earth elements", in AccessScience@McGraw-Hill,  
<http://www.accessscience.com>, DOI 10.1036/1097-8542.573400

Britannica Online Encyclopedia – Rare Earth Elements;  
<http://www.britannica.com/EBchecked/topic/491579/rare-earth-element>

### **(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

#### ***Claim Interpretation***

The limitation of claim 1, "characterized by accumulated molten particle splats" is a product-by-process limitation. The final product, a fuel electrode, is not in a molten state and so the accumulation of molten particles is a process of reaching the final fuel electrode product that has a microstructure. As such, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). Applicant discloses on page 3 of the instant specification that the "microstructure generally characterized by accumulated molten particle splats" is attributed to plasma spraying (e.g. atmospheric plasma spraying "APS", vacuum plasma spraying "VPS", plasma arc spraying, flame spraying).

***Admitted Prior Art***

On page 3 of the instant specification, applicant discloses that plasma spraying (e.g. atmospheric plasma spraying "APS", vacuum plasma spraying "VPS", plasma arc spraying, flame spraying) is a well known method of fabricating the fuel electrode. This method is useful "to reduce fuel electrode fabrication costs".

***Claim Rejections - 35 USC § 102/103***

Claims 9-12 & 15 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) as evidenced by applicant's known background art.

Tsukuda teaches a tubular solid oxide fuel cell with an air electrode, electrolyte and fuel electrode of ceramic-metal. The ceramic-metal fuel electrode is applied by plasma spraying and therefore, by applicant's admitted prior art and specification, inherently has a microstructure characterized by accumulated molten particle splats (Abstract, Sec. 1 on Pg. 364). The electrolyte is made of yttria-stabilized zirconia (YSZ) and the fuel electrode comprises nickel and zirconia (Table 1; Pg. 364, second column). An interconnector is used to connect a plurality of solid oxide fuel cells (Figs. 3 & 4).

Regarding claims 9-11, the process of using a nickel graphite mixture to obtain the nickel for the cermet is a product-by-process claim and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its

method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). The final product taught claimed does not include the graphite since it is burned off during the sintering of the electrode, "nickel graphite powder (to provide the nickel, with the graphite burning out" (Page 13 of instant specification). The final fuel electrode taught by Tsukuda comprises nickel and zirconia, the same as the claimed product. Therefore, since the final product taught by Tsukuda is the same as the final product of the instant claims, Tsukuda anticipates the instant claims.

### ***Claim Rejections - 35 USC § 103***

Claims 5-15 & 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,589,285 (Cable) in view of applicant's Admitted Prior Art.

Cable teaches a solid oxide fuel cell having a cathode of lanthanum manganite, an electrolyte with zirconia and 8 mole% of yttria, and an anode of nickel and zirconia (7:65-8:35, 10:18-20). The amount of nickel used is at least 60% and no more than 85% and the range for zirconia is more than 15% and less than 40% (16:1-20). The interfacial layer between the electrolyte layer and the anode layer is deposited by plasma spraying (8:30-35). This interfacial layer is substantially made from the anode material. A separator connects multiple fuel cells together to form a power generating system (14:44-68). A precursor layer, the interfacial layer, is formed on the fuel side.

The layer is preferably 1-50 microns and made from a zirconia composition (8:25-10:18). The solid oxide fuel cell can be tubular in shape (1:55-57).

Regarding claims 9-11, the process of using a nickel graphite mixture to obtain the nickel for the cermet is a product-by-process claim and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). The final product taught claimed does not include the graphite since it is burned off during the sintering of the electrode, "nickel graphite powder (to provide the nickel, with the graphite burning out" (Page 13 of instant specification). The final fuel electrode taught by Cable comprises nickel and zirconia, the same as the claimed product. Therefore, since the final product taught by Cable is the same as the final product of the instant claims, Cable teaches the same anode composition.

Cable is silent to the fuel electrode having microstructures characterized by accumulated molten particle splats.

Applicant admitted prior art teaches it is well known in the art to apply the fuel electrode using the plasma spray technique (Pgs. 3 & 4 of instant specification). The plasma spray technique provides the benefit of reducing the fabrication costs.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to use a different method of applying the fuel



electrode, as discussed by Cable, with the known plasma spray technique, as admitted by the prior art, to lower the fabrication costs of the fuel cell.

Claims 5-15 & 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,589,285 (Cable) in view of *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda).

The teachings of Cable and Tsukuda as discussed above are incorporated herein.

Cable is silent to the fuel electrode having microstructures characterized by accumulated molten particle splats.

Tsukuda teaches using plasma spraying to apply the nickel-zirconia mixture for the fuel electrode (Abstract, Pgs. 364-365). Plasma spraying provides good performance for the fuel cell by improving the adhesion between each of the components of the fuel cell (Abstract; Pg. 365, second column). Plasma spraying also offers the deposition of a wide range of material compositions, so the mixing ratio of the metal to ceramic can easily be controlled, which in turn controls the coefficient of thermal expansion (Pg. 366, second column). As noted above, plasma spraying inherently gives the microstructure characterized by accumulated molten particle splats.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the fuel electrode application technique of Cable with the plasma spraying technique of Tsukuda to improve the adhesion between components and thereby improve the performance of the fuel cell. Furthermore, the

coefficient of thermal expansion can be easily controlled by controlling the mixing ratios of the materials.

Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda).

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda is silent to the percent of nickel and the percent of zirconia present in the fuel electrode composition.

Tsukuda teaches the metallic material for the fuel electrode is a nickel alloy cermet with yttria-stabilized zirconia (YSZ) or a nickel alloy with aluminum oxide (Table 1; Pg. 364, second column). Figure 7 illustrates the relationship of resistance and the mixing ratio of nickel alloy with aluminum oxide, with the aluminum oxide varying between 20 – 80% (Fig. 7; Pgs. 365-366). This graph shows that varying the metal and ceramic mixture, an optimum resistance for the material can be obtained. Furthermore, the mixing ratio of the metal-ceramic material affects the coefficient of thermal expansion and controlling this ratio allows the compatibility of the fuel cell layers with respect to the coefficient of thermal expansion. While Tsukuda is silent to the composition of the nickel-zirconia mixture, Tsukuda does teach altering the mixing ratio of an equivalent fuel electrode material to improve the conductivity and the matching of the coefficient of thermal expansion.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the nickel-zirconia mixing ratio to optimize the conductivity and coefficient of thermal expansion, since it is held that discovering an optimum value of a result effective variable involves only routine skill in the art (MPEP 2144.05).

Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of US Patent 5,035,962 (Jensen).

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda is silent to the percent of nickel and the percent of zirconia present in the fuel electrode composition.

Jensen teaches a fuel electrode for an SOFC having a graded composition structure formed by successively depositing layers of nickel-yttria stabilized zirconia mixtures with different compositions (Col. 3, ll. 6-9). Table 1 (Col. 9) gives the compositions of the layers on a volume basis. In order to convert the volume percentages to weight percentages, the following formula was used:

$$\text{Weight}\%_j = \frac{\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j}{[\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j] + \text{Vol}\%_k (\text{Vol}_j + \text{Vol}_k) \rho_k} = \frac{\text{Vol}\%_j \rho_j}{[\text{Vol}\%_j \rho_j + \text{Vol}\%_k \rho_k]}$$

The densities used were obtained from [www.matweb.com](http://www.matweb.com) for yttria stabilized zirconia and nickel. The following table lists the weight percents corresponding to the volume percents of Jensen's Table 1.

Volume percent	Weight percent	Volume percent	Weight percent
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	ZrO <sub>2</sub>	ZrO <sub>2</sub>	Ni	Ni
Layer 1	70-90	63-87	10-30	13-37
Layer 2	40-60	33-53	40-60	47-67
Layer 3	10-30	7.6-24	70-90	76-92.3

As can be seen from the table Jensen teaches minimums of about 60% Ni and about 15% YSZ (claim 5) and about 70% Ni and about 20% YSZ (claim 6). Jensen also teaches maximums of about 85% Ni and about 50% YSZ (claim 7) and about 80% Ni and about 30% YSZ. The compositions of the individual layers of the multiple layer graded structure approximate a layer in which the composition is continuously graded from being high in zirconia at the electrolyte interface to being high in nickel at the external surface of the anode and meets the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the fuel electrode compositions as taught by Jensen in the fuel cell as taught by Tsukuda to meet the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of *Processing and Properties of Porous Ni-YSZ Metal/Ceramic Composites* (Clemmer), as evidenced by INCO, Ltd.

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda fails to teach that at least a portion of nickel in the fuel electrode is obtained from nickel graphite powder.

Clemmer teaches Ni/yttria-stabilized zirconia fuel cell anodes in which Ni-coated graphite particles (55% Ni content; obtained from INCO, Ltd.: Pg. 233) were used as a starting material. Generally, the anodes created from the Ni-coated graphite particles had a lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading compared to the anodes made of separate Ni and graphite particles. The hybrid structures had intermediate values of coefficient of thermal expansion and electrical conductivity (Abstract).

Nickel coated graphite particles available from INCO contain either 60 or 75% (www.incosp.com).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ni-coated graphite particles, such as those available from INCO, as a starting material for Ni/yttria-stabilized zirconia fuel cell anodes as taught by Clemmer in the fuel cell as taught by Tsukuda in order to achieve lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of US Patent 5,589,285 (Cable).

The teachings of Tsukuda as discussed above are incorporated herein; however, the reference is silent to the precursor layer between electrolyte and fuel electrode containing zirconia.

Cable teaches an SOFC with a cathode containing lanthanum manganate (Col. 7, l 66 – Col. 8, l 2), an electrolyte of yttria-stabilized zirconia (Col. 8, ll. 12-14), and an anode containing a nickel powder mixed with zirconia (Col. 10, ll. 18-20). Between the electrolyte and anode, an interfacial layer (applicant's precursor layer) containing sulfur tolerant material is disposed (Col. 3, ll. 1-3); the interfacial layer may contain Y-doped  $ZrO_2$  (Col. 10, ll. 1-4; applicant's zirconia). The thickness of the interfacial layer is generally 1-100  $\mu m$ , preferably less than 50  $\mu m$  (Col. 8, ll. 35-37). The interlayer serves to improve electrical contact between the electrolyte and anode and provides an environment in which the species can interact or react because the interlayer keeps sulfur from the fuel from poisoning the anode, particularly Ni/YSZ cermet anodes (Col. 8, ll. 19-34; Col. 6, ll. 55-63; Col. 18, ll. 23-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the Y-doped zirconia interlayer as taught by Cable between the anode and the electrolyte of the fuel cell as taught by Tsukuda in order to improve electrical contact and provide an environment in which the species can interact or react.

#### **(10) Response to Argument**

*Tsukuda and claims 9-12 and 15 under 35 USC 102(b)/103(a):*

Appellant states on page 7 of the appeal that the product-by-process interpretation for claims 9-11 is a "new interpretation" that has not been "previously set forth". However, the Non-Final office action of 8/25/06 that was subsequently appealed on 10/31/06 included the same interpretation. In the appeal brief of 10/31/06, appellant did not dispute the product-by-process interpretation of the same claims 9-11. As discussed in the above rejection, the interpretation is based on appellant's instant specification page 13, where appellant teaches the final product does not include the graphite because it is burned off during the sintering process of the electrode. The final product taught by Tsudaka comprises nickel and zirconia, the equivalent product claimed by appellant.

Appellant argues on page 8 of the appeal, *"since the term 'nickel graphite powder' recites the structural end of the nickel portion of the fuel electrode, it is properly held as structure - not process."* First, 'nickel graphite powder' is not the structural end of the nickel portion of the fuel electrode, but is in fact the opposite. Nickel is the structural end of the nickel graphite powder, as discussed by appellant's instant specification on page 13. Since the structural end is "a ceramic-metal fuel electrode comprising nickel and zirconia" as recited by the claims and the graphite is not part of the structural end product as claimed or described in the instant specification, the nickel graphite powder becomes part of the process of obtaining the structural end product of a fuel electrode comprising nickel and zirconia. As discussed in the above rejection, Tsudaka teaches the claimed end product. Second, it isn't 'nickel graphite powder' per se that forms the process but the entire claim limitation of "nickel graphite powder is

used to obtain at least a portion of the nickel." So the claim limitation points out that all the nickel in the end product is not required to be obtained by the nickel graphite powder. Claims 10 and 11 further illustrate that the final product of a nickel and zirconia electrode can be made by multiple amounts of nickel and graphite in the powder. As such, the claim interpretation as product-by-process is correct and has been rejected properly. Determination of patentability is based on the product itself and the patentability of a product does not depend on its method of production. It should be noted that claims 5-8 were not rejected under 35 USC 102 because the claimed final product actually required particular amounts of nickel and zirconia that are not required by the final product of claims 9-12 & 15.

Regarding the arguments of claim 12 on page 8, appellant argues "*Claim 12 recites that a yttria stabilized zirconia powder is used to obtain at least a portion of the zirconia element of the electrolyte. The Examiner ignores this limitation and does not even contend that it is a product-by-process limitation.*" However, claim 12 does not recite this limitation. The inclusion of zirconia in the electrolyte is not a limitation of claim 12. The limitation that yttria stabilized zirconia makes up a portion of the zirconia in the electrode is claimed and this claimed limitation is discussed in the rejection and taught by Tsukuda.

Appellant argues the rare-earth element stabilized zirconia of claim 15 is not taught by the prior art since only yttria stabilized zirconia is taught and yttrium is not considered a rare-earth element according to Chemical Elements.com web page showing the Periodic Table of Rare Earth elements. However, no definition of the rare-



earth elements was provided in the instant specification. Yttrium and Scandium are well known rare-earth elements. The following definitions provide evidence that Yttrium and Scandium are known as rare-earth elements:

From *Science and Technology Encyclopedia (McGraw-Hills Access Science)*,  
The group of 17 chemical elements with atomic numbers 21, 39, and 57-71; the name lanthanides is reserved for the elements 58-71.

From *Britannica Concise Encyclopedia*, Any of a large class of chemical elements including scandium (atomic number 21), yttrium (39), and the 15 elements from 57 (lanthanum) to 71.

From *Rare Element Resources LTD*, The rare-earth elements are the 15 lanthanide-series elements, with atomic numbers 57 through 71, which are in Group IIIA of the Periodic Table. Yttrium (atomic number 39), a Group IIIA transition metal, although not a lanthanide is generally included with the rare-earth elements, as it occurs with them in natural minerals and has similar chemical properties. Also, commonly included with the rare-earth elements because of their similar properties are scandium (atomic number 21 and thorium (atomic number 90).

Therefore, since no definition of rare earth elements is provided by the appellant in the instant specification, the common definition of a rare-earth element, which is well known in the art, is used. The above resources provide evidence that yttrium, as taught by Tsudaka, is a rare-earth element and therefore the limitation was not ignored but addressed and shown as taught by the prior art.

*Claims 5-15 & 18 rejected under 35 USC 103(a) in view of Cable:*

Appellant points out that this rejection was overturned by the Board of Appeals by the Decision of 10/31/07. In that decision, the Board determined that while plasma deposition was taught by Cable, "There is no disclosure that 'plasma deposition' includes plasma spraying" (Decision pg. 6). However, as will be discussed below, Cable teaches plasma spraying as an application technique (12:29-35).

On page 9 of the instant brief, appellant "*respectfully request the Examiner to cite where Cable supposedly provides this discussion.*" Cable teaches plasma spraying as an application technique for the same material comprising the anode and calls the layer a microslip zone (12:29-35). The microslip layer is between the interfacial layer and the anode layer and can be applied by the known plasma spraying technique. This microslip layer is also comprised of anode (fuel electrode) material (10:59-65) and can be an integral or continuous layer with the bulk electrode (i.e., anode) (11:4-10). As discussed in the rejection, Cable teaches applying an interfacial layer that comprises the same fuel electrode (anode) material (3:13, 3:23, and 6:55-61) by plasma deposition or screen printing (8:32-35). So Cable teaches the same nickel zirconia fuel electrode material can be and is known to be applied by plasma spraying, which is a form of plasma deposition.

Appellant argues that "*Applicants never made the admission that the Examiner claims they made.*" and then points to page 4 lines 6-14 of the instant specification. As noted in the rejection the cited passage from appellant's instant specification come from

page 3. On page 3, line 16 of the instant specification, teaches in the background art that, "Other attempts to reduce fuel electrode fabrication costs include plasma spraying ... to form a deposited layer having a microstructure generally characterized by accumulated molten particle splats." The paragraph goes on to cite multiple references that teach plasma spraying as well known in the art. Another example illustrating the known use of plasma spraying a nickel zirconia mixture for a fuel electrode is provided by US 3,503,809 (Spacil). Also, "Ceramic Films and Coatings" by Herman illustrates plasma spraying of mixed metal ceramic materials is well known and discusses the benefits. So, appellant teaches that the plasma spraying technique has been known in the art and it has been known for application of the fuel electrode as a cost reducing method.

Therefore, Cable teaches plasma spraying the interfacial layer and the microslip layer, both having the same material as the anode, and that these layers aid in adhering the anode to the electrolyte and provide a better thermal expansion match between layers (11:49-60). Combining Cable's teachings with that which is known in the art, namely plasma spraying of the fuel electrode and that plasma spraying reduces fabrication costs, as discussed by appellant, it would be obvious to one skilled in the art to use plasma spraying to apply the anode material for the tubular solid oxide fuel cell of Cable.

Furthermore, appellant admits that Cable teaches a superior method of applying the anode material by plasma spraying. On page 10 of the instant brief, appellant alleges no motivation for a combination of references. Appellant argues the skilled

artisan would not use Tsukuda's 'reliable' method of applying the anode material over "Cable's *adhesion superior deposition technique*" (Brief pg. 10). The only deposition technique taught by Cable is plasma deposition (8:33), which as discussed above includes plasma spraying. So appellant admits that Cable teaches a superior method of applying anode material by plasma spraying. As such, the instant claims are at least obvious over the teachings of Cable.

Appellant argues that Cable teaches away from a tubular design since a planer fuel cell is exemplified for use with sulfur bearing fuels. First, Cable doesn't teach away from tubular fuel cells as a structure for solid oxide fuel cells. Cable teaches that co-fired or bonded solid electrolyte fuel cells are not tolerant of using sulfur bearing fuels (2:3-5). These co-fired or bonded solid electrolyte fuel cells, as taught by Isenberg et. al., are preferably tubular in shape. Second, Cable teaches that the sulfur tolerant fuel cells are preferably planer, not that they must be planer. "*Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.*" (MPEP 2132 (II)). Further, appellant's arguments are not commensurate in scope with the claims since none of the claims recite the solid oxide fuel cell must be tolerant to sulfur bearing fuels or discuss in any manner sulfur bearing fuels. The type of fuel used to operate the fuel cell is not recited in the claims or discussed in the instant specification. The claimed limitations deal with a tubular solid oxide fuel cell having a nickel zirconia fuel electrode with a feature inherent to plasma spraying. Cable teaches a tubular solid oxide fuel cell that has a nickel zirconia fuel electrode. The method of applying the same fuel electrode material is taught to include

the known method of plasma spraying and therefore it would be obvious to one skilled in the art to use this method for applying the same material for the fuel electrode to reduce production costs. Furthermore, combining prior art elements according to known methods to yield predictable results and using known techniques to improve similar devices in the same way are considered obvious to one of ordinary skill in the art (KSR, MPEP 2141 (III)).

Regarding appellant's argument that "It is error for the Examiner to simply ignore that Cable explicitly teaches that its disclosure is incompatible with Tsukuda's fuel cells.", this rejection does not include the teachings of Tsukuda and therefore this argument is not commensurate with the rejection.

*Claims 5-15 & 18 rejected under 35 USC 103(a) over Cable in view of Tsukuda:*

Appellant argues the motivation to combine Tsukuda's plasma spraying with Cable's solid oxide fuel cell is misplaced because allegedly Tsukuda's plasma spraying is only 'reliable'. First, 'reliable' is a great improvement over something that isn't reliable. Second, Tsukuda actually teaches, "The application of plasma spraying to tubular SOFC production has resulted in cells with good performance" (Abstract, pg. 368: Conclusions). As discussed above, appellant alleges no motivation to use Tsukuda's 'reliable' method of applying the anode material over "Cable's *adhesion superior deposition technique*" (Brief pg. 11). Appellant's arguments directed to a 'superior technique' and a 'reliable' technique are completely unsupported by the prior art and no support or evidence is provided to back up these statements. Furthermore,

the only 'deposition' technique taught by Cable is plasma deposition (8:33), which as discussed above includes plasma spraying. So appellant admits that Cable teaches a superior method of applying anode material by plasma spraying. As such, the instant claims are at least obvious over the teachings of Cable in view of Tsukuda, which would teach that plasma spraying is (according to appellant) a superior technique and a reliable adhesion method for fuel electrodes (as taught by Tsukuda).

*Claims 5-8 rejected under 35 USC 103(a) over Tsukuda:*

Appellant argues a particular parameter is not established by Tsukuda for the results effective variable argument and that *"Examiner has not met the burden of showing that nickel-zirconia percentage limitations are recognized as results effective variables"*. Tsukuda shows in figure 7 and in the last paragraph of page 365, the result effective variable relationship between the mixing ratio of  $\text{Al}_2\text{O}_3$  to Ni alloy and the coating resistance. In other words, as the mixing ratio of the two components changes, so does the resistance of the coating material. Table 1 on page 365 relates the two possible fuel electrodes as either a Ni-  $\text{Al}_2\text{O}_3$  cermet or a Ni- $\text{ZrO}_2$  cermet (appellant's anode material). Since the Ni-  $\text{Al}_2\text{O}_3$  cermet is an equivalent material to Ni- $\text{ZrO}_2$  for the fuel electrode, the coating resistance is a result effective variable of the mixing ratio of nickel and zirconia. Furthermore, on page 366, Tsukuda also teaches, "Since the coefficient of linear thermal expansion is proportional to the mixing ratio of metal to ceramic [cermet], control of this ratio allows the achievement of both compatibility between the coefficients of linear expansion and acceptable conductivity." This

teaching is a prime example of results effective variable and there is no teaching away in the prior art of Tsukuda.

Appellant argues "*Thus, Cable clearly and specifically teaches away from Applicants' claimed tubular fuel cell invention. Therefore, the rejection fails.*"; however, the prior art of Cable is not part of this rejection and nor are claims 9-15 as discussed by appellant.

*Claims 5-8 rejected under 35 USC 103(a) over Tsukuda in view of Jensen:*

Appellant argues the combination is illogical and confusing based on previous rejections, the fact that Jensen assigned his invention to the appellant and that the final product would be a graded electrode made by sintering. These arguments are not commensurate with the rejection presented and the rejection of record has not been addressed by appellant. However, the following is a response to appellant's arguments. One, the fact that Jensen assigned the invention to the appellant doesn't lessen it as prior art or the teachings it presents. Two, claims 5-8 are rejected over Tsukuda in view of Jensen, without mention of Cable. So the arguments with respect to the combination of Cable are unclear since that isn't the rejection presented. Three, while Jensen teaches sintering as one possible application method, spraying is also taught as an application method (5:27-28). Four, Jensen teaches a motivation to use the electrode composition since it improves the fuel cell performance by meeting the simultaneous requirements of good adhesion to the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity (4:20-25). This is the reason and motivation for using

the teachings of Jensen in view of Tsukuda. Finally, the fact that the fuel electrode may or may not be graded does not detract from the teachings of the nickel and zirconia content of the fuel electrode.

As such, the arguments presented by appellant are not commensurate with the rejection presented and the rejection of record meets the limitations of the claims and renders the instant claims obvious. Appellant alleges claims 6 and 8 are not met. Appellant's basis for the method of "taking 1/3 the respective weights of each of the 3 layers" is unclear and analysis is not commensurate with the claimed invention. The claim just requires the electrode to comprise various percentages and as illustrated in the table presented in the Jensen rejection, at least layer 3 reads on claim 6 and layers 3 and 2 read on claim 8.

*Claims 9-11 rejected under 35 USC 103(a) over Tsukuda in view of Clemmer:*

Regarding appellant's point (1) and the rationale behind the amount of nickel in the nickel graphite powder, it would be obvious to one skilled in the art that the higher the nickel content in the powder, the more nickel that will be applied per volume of material. The lower the nickel content the less nickel applied per volume of material. This would affect the porosity of the electrode since the graphite is burned out leaving a void. Therefore, it would be obvious to one skilled in the art to choose the nickel content based on parameters such as porosity. As pointed out by appellant, Clemmer teaches a relationship or result effective variable for the coefficient of thermal expansion and the electrical conductivity based on the variations in the amount of nickel loaded on



the graphite particles. The INCO data is included since Clemmer teaches using INCO supplied materials and the available INCO materials have various loadings of nickel coated carbons. Each of the available type is also shown to have different conductivities and densities. Therefore, it would be obvious to one skilled in the art to vary the loading of nickel coated carbon to vary the density of the electrode and the conductivity of the electrode, as illustrated by INCO and taught by Clemmer.

Regarding appellant's point (2) that Clemmer teaches nickel coated graphite not "separate Ni and graphite particles". This argument is not commensurate in scope with the claims since "separate Ni and graphite particles" are not recited in the claims. Clemmer teaches the same type of particle as claimed and therefore renders obvious the claimed invention.

*Claim 18 rejected under 35 USC 103(a) over Tsukuda in view of Cable:*

Appellant presents no new arguments. As such, the same response as discussed above applies here. Namely, Cable does not present a "teaching away". No picking and choosing has been done with any of the references and the references cited have been considered and presented as a whole. The argument regarding the sulfur bearing fuels has no impact on the current claims since this is not a limitation presented in the claims and the fuel cells ability or inability to use sulfur bearing fuels does not materially affect the combinations of the references or their applicability to the instant claims.

**(11) Related Proceeding(s) Appendix**

Copies of the court or Board decision(s) identified in the Related Appeals and Interferences section of this examiner's answer are provided herein.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Keith Walker

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